

Apple, Loyal E.

THE DEVELOPMENT AND DELIVERY OF  
SENSORY AIDS IN THE UNITED  
STATES.

HV 1701

Ap 52



**M.C. MIGEL LIBRARY**  
**AMERICAN PRINTING**  
**HOUSE FOR THE BLIND**

The Development and Delivery of Sensory Aids  
in the United States

by: Loyal E. Apple  
Executive Director



## Abstract

This paper presents a general description of the basic service delivery system for rehabilitation and education of the blind and partially sighted in the United States and the way research and development of sensory aids and personnel training relate to this system. Several types of sensory aids are described and their development discussed. There is also a discussion of the impact of micro-processor technology on the development of sensory aids for the blind. The paper is illustrated with charts and tables.



## Introduction

It is my purpose to describe for you some of the sensory aids which have been developed in the United States for use by visually handicapped children and adults. In addition, I will discuss how these aids were developed, funded and applied by the service delivery system. But first, we must begin by answering the question, "Who uses these sensory aids?"

The current population of the United States is 220 million people. It is estimated that by the year 2020, the overall population will have increased by a minimum of 17 percent.

Ninety million Americans wear glasses, and there are ten million more who have visual disorders such as night blindness, loss of sight in one eye, or color blindness which cause a functional change in their visually-guided behavior.

More significantly, there are 1.7 million Americans who are not able to read regular newspaper print with ordinary glasses. Out of this group, there are approximately 500,000 Americans who fall within our legal definition of blindness, with 20 percent having no useful vision.

The definition of blindness in the United States, converted to the metric system, is visual acuity of 6/60 meters in the better eye with correction or greater vision if there is a field defect subtending an angular distance no greater than 20 degrees. The definition of "partially sighted", frequently used in the school system is visual acuity of 6/21 meters.

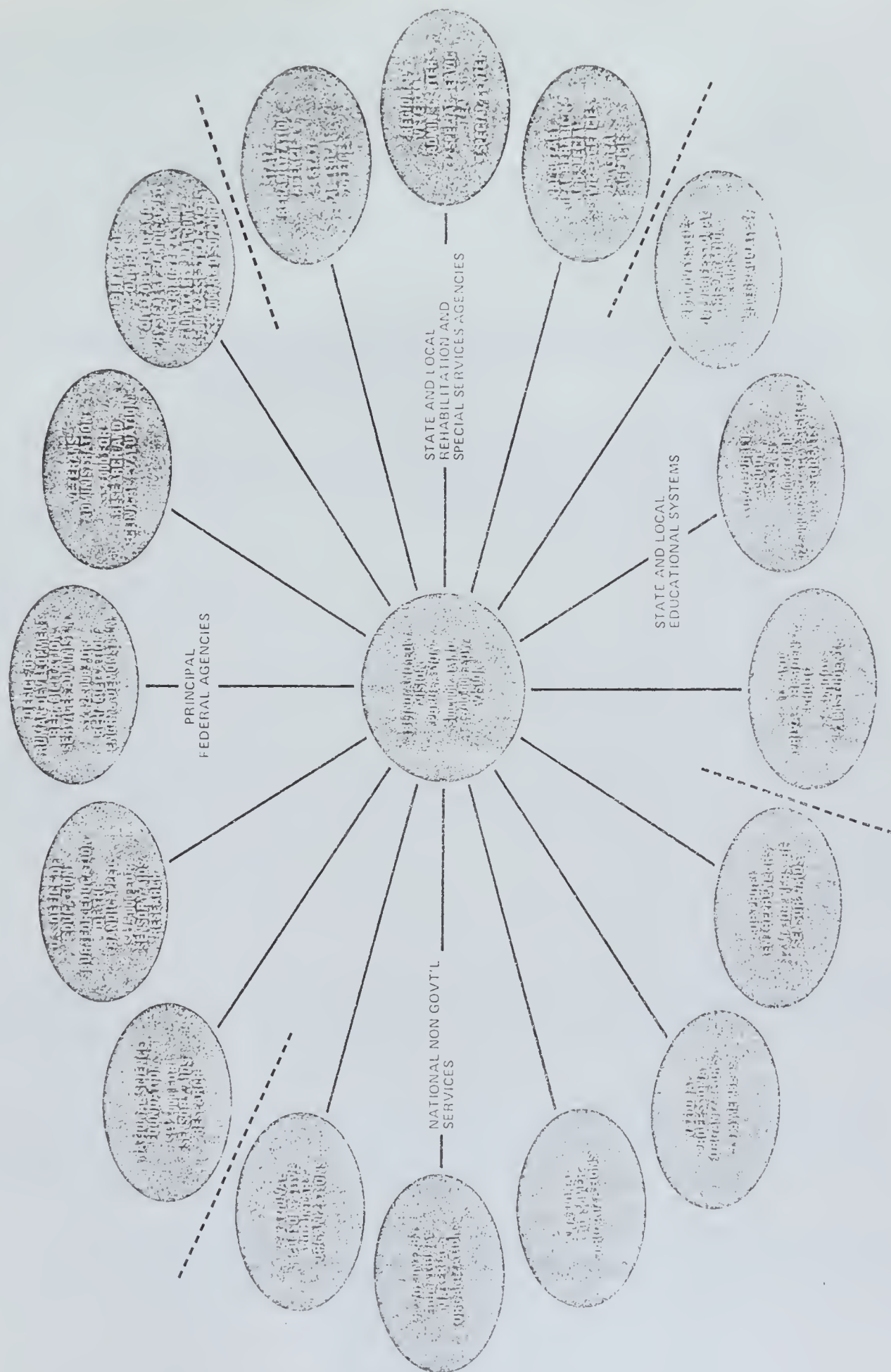
At present, over 50 percent of the legally blind persons in the U.S. are 65 years or older. With a 92 percent increase forecast in this population over the next 50 years, this indicates that there could be a significant increase in the number of people with visual disorders.

There are 33,600 legally blind and an estimated 122,000 partially sighted children in public schools in the U.S. and approximately 5,000 youths and adults receiving university or technical training. We also estimate that about 100,000 legally blind Americans are employed in business and industry.

I would now like to move into a description of the many research and service organizations that participate in the development of sensory aids in the United States. (See Exhibit I: The U.S. Service Network for the Blind and Low Vision Population - on the following page.)



# THE U.S. SERVICE NETWORK FOR THE BLIND AND LOW VISION POPULATION — JULY 1977





To start with, there are 40 federal agencies which have planning, regulatory or funding responsibility for research and service through facilities which are not all governmental. The major federal agencies are: the Bureau for the Education of the Handicapped (BEH), in the Office of Education; the Rehabilitation Services Administration (RSA), in the Office of Human Development; the Veterans Administration (VA), the National Science Foundation (NSF); and the Division for the Blind and Physically Handicapped in the Library of Congress. Their funding for the research and development of sensory aids for fiscal '77 is shown in Exhibit II, below.

Expenditures on Sensory Aids, Research and  
Evaluation by Selected Government  
Agencies, Fiscal 1977

| <u>Agency</u>                                                             | <u>Purpose of Expenditure</u>                            | <u>Amount</u>      |
|---------------------------------------------------------------------------|----------------------------------------------------------|--------------------|
| Office of Human Development<br>Rehabilitation Services<br>Administration  | Rehabilitation Engineering<br>and Demonstration Projects | \$1,825,000        |
| U.S. Office of Education<br>Bureau for Education of<br>the Handicapped    | Research                                                 | 475,000            |
| Veterans Administration                                                   | Research and Clinical<br>Evaluation                      | 554,000            |
| Library of Congress<br>Division for the Blind<br>& Physically Handicapped | Support Sensory Aids<br>Research and Development         | 350,000            |
| National Science Foundation                                               |                                                          | 112,000            |
|                                                                           | Total                                                    | <u>\$3,316,000</u> |

In addition, government agencies such as the Administration on Aging, Department of Transportation, National Eye Institute, and the National Institute on Aging carry out research on visual disorders as they pertain to each agency's particular overall purpose.

Also, there are four categories of national, non-governmental, non-profit organizations which play an important role in gathering and disseminating information about research, helping shape public opinion and guiding the direction of the research community.

The four groups are professional organizations such as the American Association of Workers for the Blind, the Association for Education of the Visually Handicapped, National Council of State Agencies for



the Blind, Division for the Visually Handicapped of the Council on Exceptional Children, and the Affiliated Leadership League of and for the Blind of America; organizations of visually handicapped persons such as the American Council of the Blind, the Blind Veterans Association, and the National Federation of the Blind; organizations of volunteers such as the National Braille Association, Recording for the Blind; and special purpose agencies such as the American Foundation for the Blind, National Industries for the Blind, and the American Printing House for the Blind.

No review of the research and development system of sensory aids would be complete without mentioning the outstanding university system in the United States which trains service personnel for the field of blindness. In most of the programs the students are first trained with sophisticated aids and then taught how to teach the use of these aids to blind persons.

There are 67 universities which train rehabilitation counselors; 28 universities which train special education teachers for the blind and visually handicapped; 10 universities which train orientation and mobility specialists, and 7 universities which train rehabilitation teachers. The number of graduates of these university programs in 1976 is shown in Exhibit III, below.

Blindness Service Professionals -  
Graduates of University Programs, 1976

| <u>Type of Program</u>                             | <u>No. of Programs</u> | <u>No. of Graduates</u> |
|----------------------------------------------------|------------------------|-------------------------|
| Vocational Rehabilitation<br>Counselors, Blindness | 67                     | 80 <sup>1)</sup>        |
| Rehabilitation Teachers                            | 7 <sup>2)</sup>        | 30                      |
| Orientation and Mobility<br>Instructors            | 10                     | 120                     |
| Special Education Teachers<br>for the Blind        | 28 <sup>3)</sup>       | <u>300</u>              |
|                                                    | Total                  | 530                     |

- 1) In 1976, 800 persons graduated from vocation rehabilitation courses. Ten percent chose blindness as their specialty field.
- 2) Includes two new programs initiated in 1976.
- 3) Includes 22 programs supported by U.S. Office of Education.

The Bureau for the Education of the Handicapped has used the university system extensively for intensive teacher training in low vision and is currently employing it for intensive training in Optacon



reading machines. University intensive training has also been used for orientation and mobility professionals who wish to develop their skills and knowledge in the teaching of the use of electronic mobility devices.

Multi-state "regionalization" is an important aspect of the service delivery system because it enables different components of the system to come together to develop quality service. These local service facilities are so important to the deployment of sensory aids, that I would like to outline them for you.

There are 54 state-federal vocational rehabilitation agencies and special purpose units for the blind and visually handicapped with 490 offices. The Veterans Administration has 72 special service teams and nine special rehabilitation centers. There are 54 state-operated residential schools for blind children with an estimated total population of 8,400 students. Today, however, more and more children are being "mainstreamed" into public schools. "Mainstreaming" provides equal educational opportunities for all children regardless of their handicapping conditions to receive appropriate education in the least restrictive environment with their un-handicapped peers. Residential schools for the blind, therefore, are becoming more geared toward educating multiply handicapped blind children.

In addition to these agencies which are funded by the government, there are also about 250 private non-profit agencies in the service delivery system.

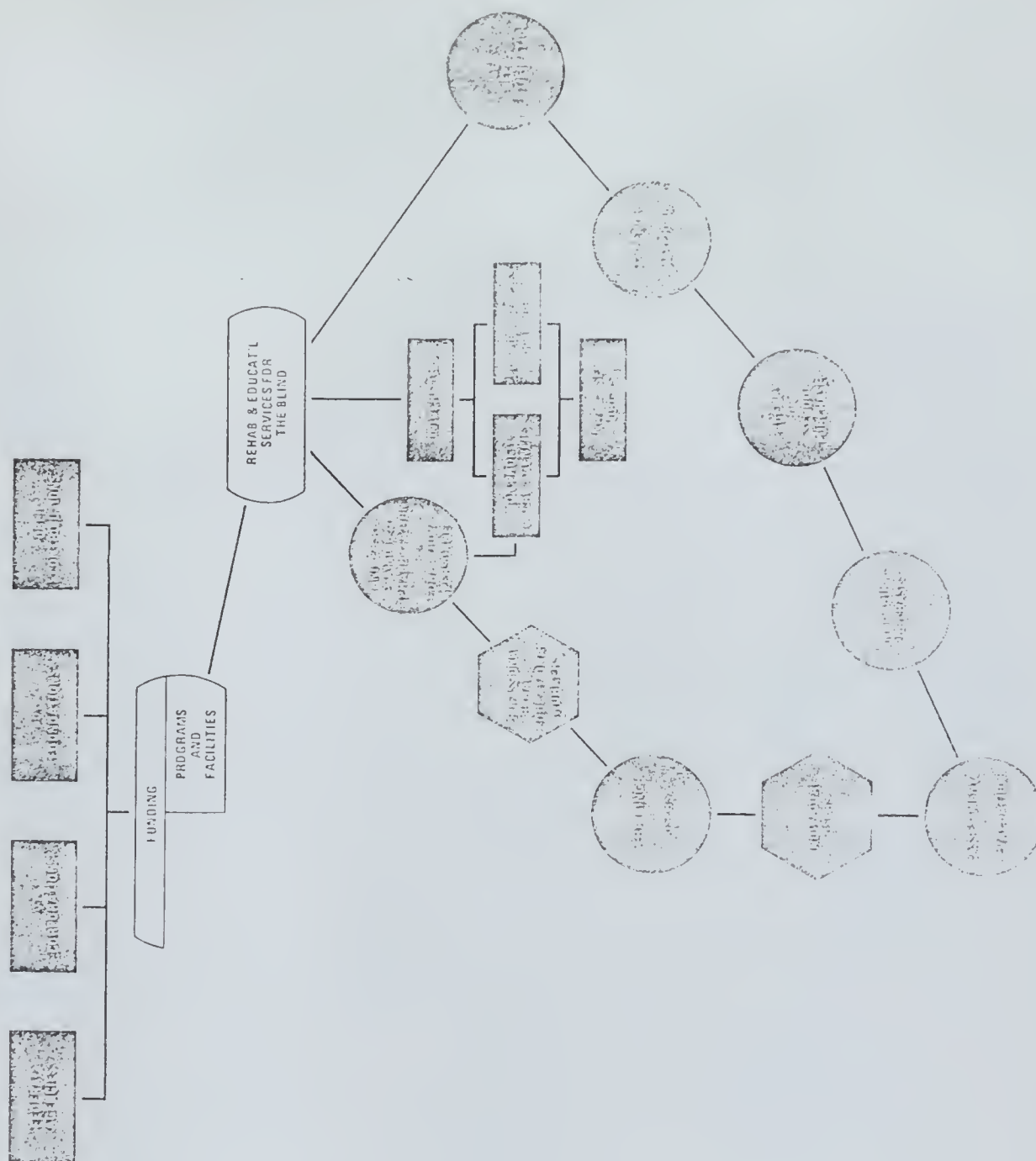
Typically, an individual with a visual problem goes to his physician who refers him to a local agency for the blind for rehabilitation training or services. The local agency then seeks payment for its services from the state-federal vocational rehabilitation agency or governmental medical care. (See Exhibit IV: The Sensory Aids System Cycle - Funding Sources and User Demand, Page 7.)

Another major group which has entered the sensory aids development field in the past ten years is private industry. These researchers and entrepreneurs from about a dozen firms from the private sector, have developed the necessary manufacturing capability and marketing and sales skills to deal effectively with the service delivery system and to meet the sensory aids needs of blind and visually handicapped persons. The corporations either obtain government grants or contracts or they work from a private capital base or combine the two. Notable examples of such organizations include Telesensory Systems, Inc., Visualtek, Apollo Laser, Master Specialties, Science for the Blind Products and Triformation Systems, Inc. These organizations carry on their sales efforts through regional offices and personnel. (See Exhibit V: The Sensory Aids System Cycle - Funding Sources and Production/Distribution, Page 8.)

During recent years philanthropic foundations have been participating in the development of sensory aids and have been very active during fiscal '77 in supporting the development of reading machines for the blind. For example, two prominent foundations have made grants of \$200,000 recently for testing and evaluating the Kurzweil Reading Machine.

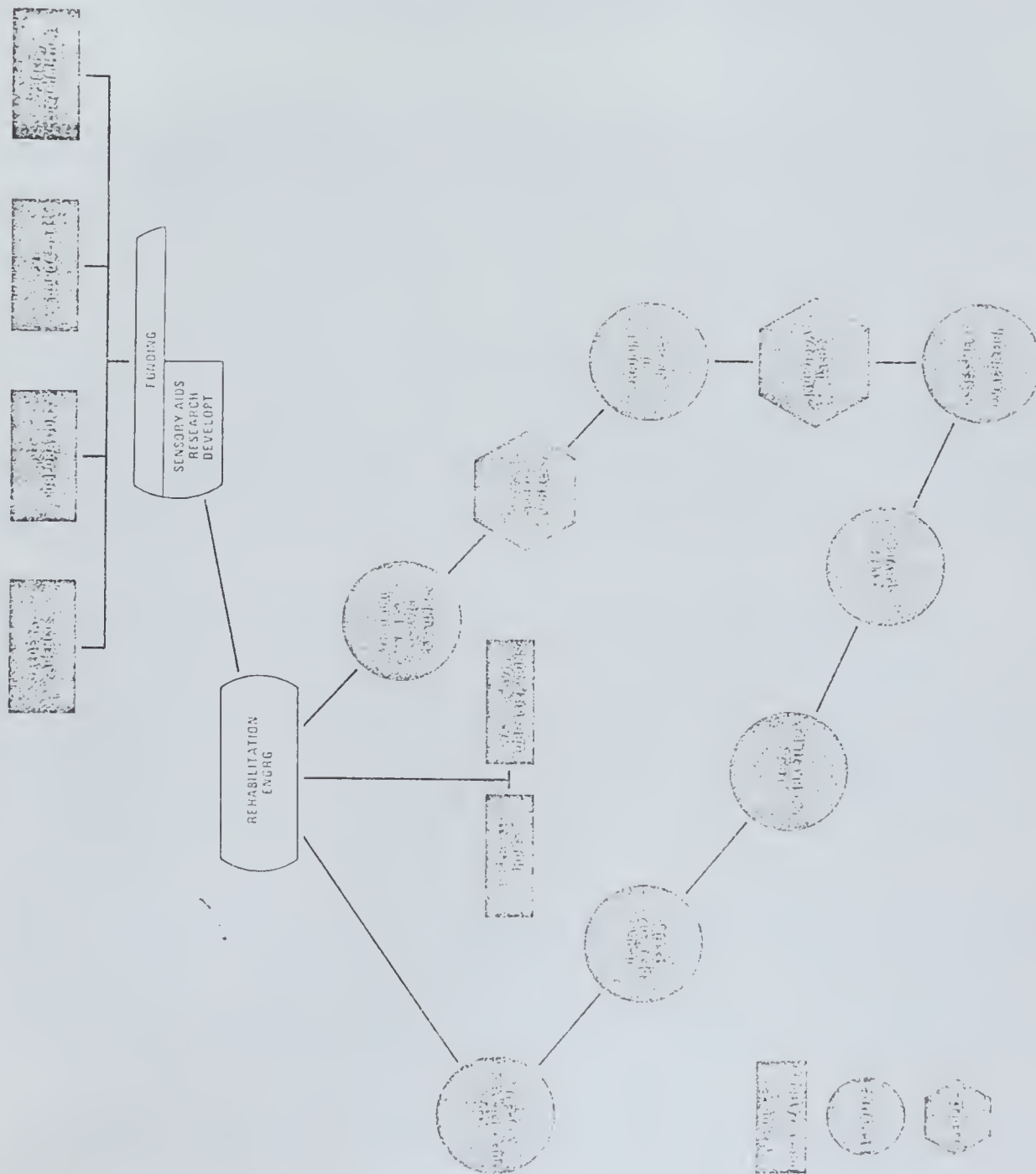


# THE SENSORY AIDS SYSTEM CYCLE SOURCES OF FUNDING AND USER DEMAND





THE SENSORY AIDS SYSTEM CYCLE FUNDING SOURCES AND PRODUCTION / DISTRIBUTION





There are also some non-profit organizations that develop, manufacture or market sensory aids such as the American Foundation for the Blind, American Printing House for the Blind, Howe Press, and the New York Association for the Blind.

All four have extensive mail order catalogs. The American Foundation for the Blind's catalog contains 475 items, most of which are aids for home use. Consisting mainly of materials for use in schools, American Printing House for the Blind's catalog contains 400 educational aids and Howe Press' catalog contains 115 items. The New York Association for the Blind markets 80 items which require prescriptions.

In addition to mailing out catalogs and sending notices about sensory aids to periodicals in the blindness field, the American Foundation for the Blind also prepares public education materials including press releases and radio and television spot announcements about new devices.

The American Foundation for the Blind also publishes the International Guide to Aids and Appliances for Blind and Visually Impaired Persons, which is the only comprehensive source of information about aids and devices for the visually impaired in the world. It contains descriptions, pricing and ordering information for more than 1500 devices available from 270 distributors from 28 countries.

The three largest sensory aids markets in the U.S. are braille watches, canes and talking book machines. The AFB, for example, sells approximately 12-15,000 braille wrist and pocket watches per year. The Foundation carries sixteen types of canes of various lengths and sells approximately 12-13,000 per year. The Division for the Blind and Physically Handicapped in the Library of Congress, purchases approximately 45,000 Talking Book machines with turntables and 55,000 cassette players.

### Models of the Development and Delivery of Sensory Aids

So far, I have presented an overall view of the kinds of organizations involved in the development of sensory aids in the U.S. I would now like to delineate more clearly the various developmental stages that particular sensory aids go through from concept to production and use by blind or visually handicapped persons. (See Exhibit VI: The Sensory Aids System Cycle for the Blind in the U.S., Page 10.)

The approximate nature of these stages can be outlined as follows: Identification of need/concept development, prototype development, evaluation, manufacturing, training of trainers, sales and services, and user training. Communications and funding of various sorts comprise the glue which bind these stages together. (See Exhibit VII: The Sensory Aids System Cycle Training of Professionals/Sales and Service Personnel, Page 11.)

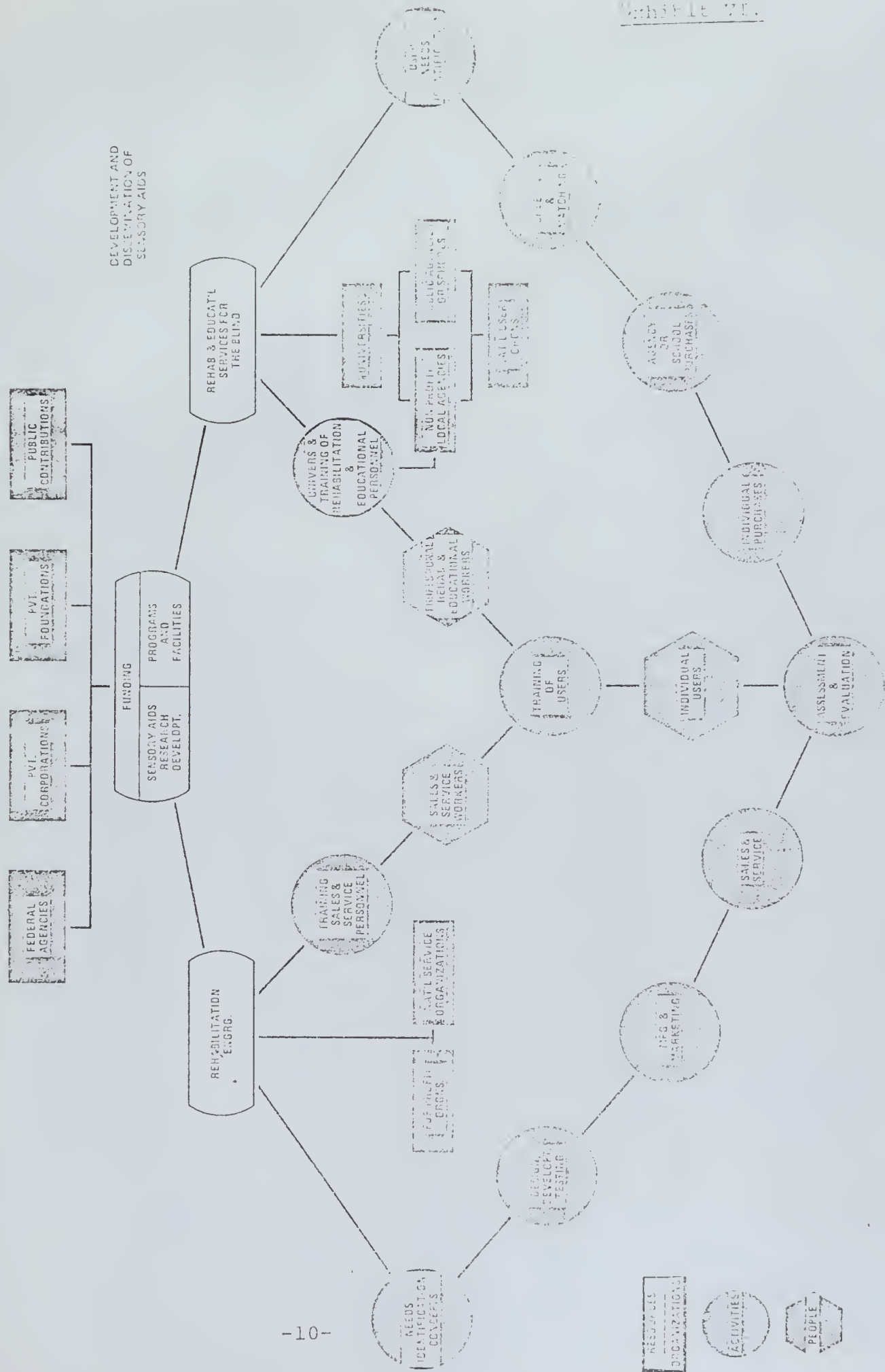
Not all devices, however, pass through all of these stages. In particular, some relatively simple devices may require little or no training to operate.

The following are some case histories of devices developed recently in the United States:



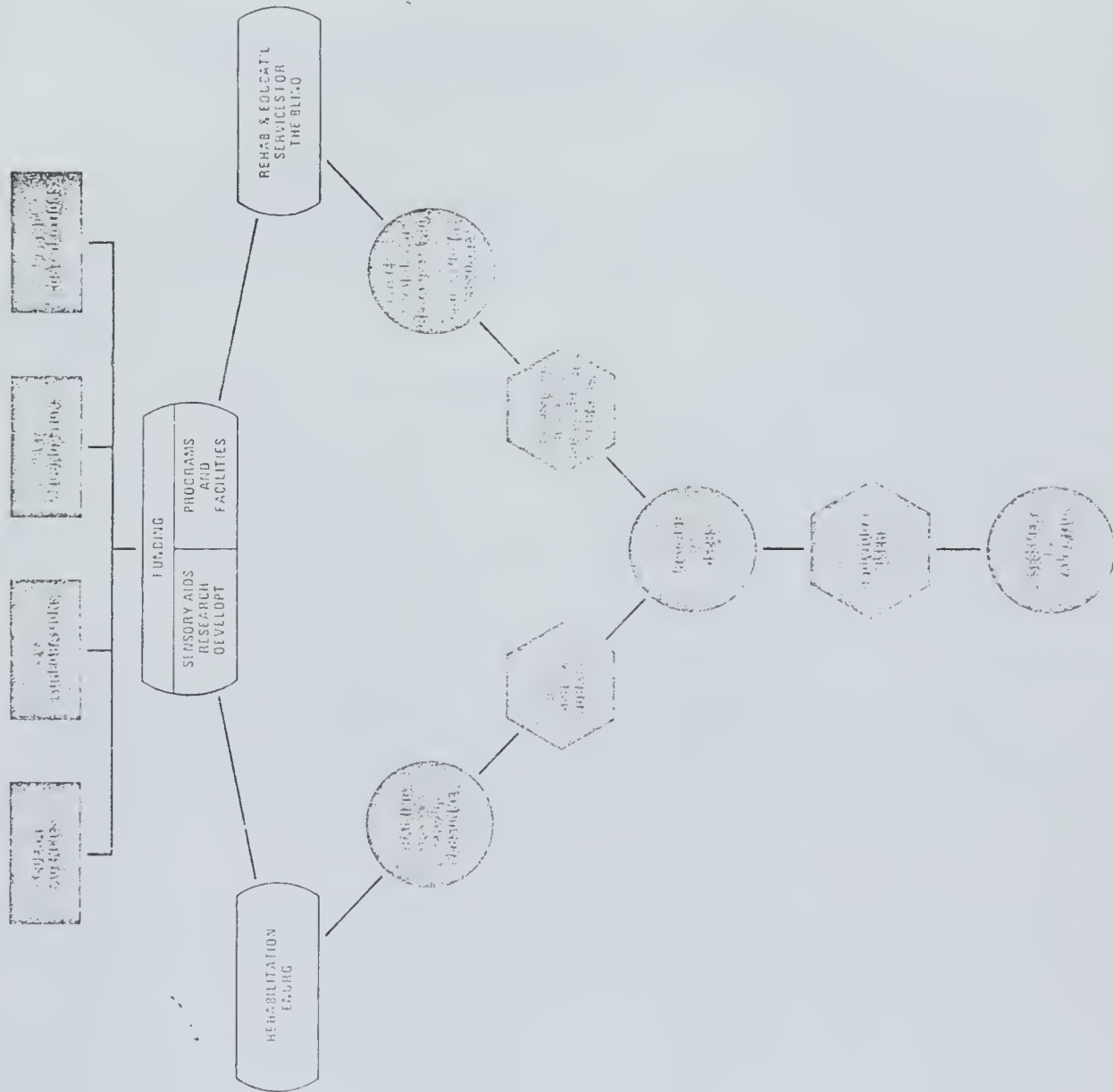
# THE SENSORY AIDS SYSTEM CYCLE FOR THE BLIND IN THE U.S.

APPENDIX VI.





# THE SENSORY AIDS SYSTEM CYCLE TRAINING OF PROFESSIONAL/SALES AND SERVICE PERSONNEL





within the past several years, four electronic calculators have been widely distributed in the United States. Telesensory Systems, Inc. and Master Specialties both manufacture calculators with audible outputs that announce every entry and every result.

The American Foundation for the Blind offers standard and scientific models of an electronic calculator that have both braille and visual readouts. Science for the Blind Products manufacture a scientific calculator which has been modified to print braille on a paper tape. Sales and prices of these devices are shown in Exhibit VIII, below.

Electronic Calculators for the Blind -  
by Type, Source, Sales and Price -  
January, 1976 - June, 1977

| <u>Type</u>                                    | <u>Company</u>                       | <u>Units Sold</u> | <u>Price</u> |
|------------------------------------------------|--------------------------------------|-------------------|--------------|
| Speech Plus                                    | Telesensory Systems                  | 2,087             | \$395.00     |
| Audio Response                                 | Master Specialties                   | 350               | 565.00       |
| Basic Scientific<br>model, Braille<br>Printout | Science for the Blind                | 30                | 895.00       |
| AFB Braille<br>Electronic                      | American Foundation<br>for the Blind | 59                | 375.00       |
| AFB Braille<br>Scientific                      | American Foundation<br>for the Blind | 14                | 425.00       |

Video low vision aids magnifying up to seventy times were also developed within the past decade. They are more complex and require some training by the user. A national research organization, Rand Corporation, under government grant developed the basic concept and recruited private entrepreneurs to manufacture and market the devices.

Video low vision aids systems are based on closed circuit television and are designed to magnify printed materials electronically and provide adjustment of contrast. The major components of these visual aids are a mounted camera, a self-contained light source, a lens capable of magnifying print to various sizes which can be adjusted to individual specifications, and a monitor or television screen. The major manufacturers of these devices in the U.S. are Visualtek, Pelco Sales, Inc., Videovision, and Apollo Lasers, Inc. (See Exhibit IX, Page 13.)



Video Low Vision Aids -  
by Type, Source, Sales and Price -  
January, 1976 - June, 1977

| <u>Type</u>                       | <u>Source</u>       | <u>Units Sold</u> | <u>Price</u> |
|-----------------------------------|---------------------|-------------------|--------------|
| Visualtek Video Low Vision Aid    | Visualtek, Inc.     | 1,200 (est.)      | \$1,400      |
| Apollo Electronic Visual Aid      | Apollo Lasers, Inc. | N.A.              | 1,695        |
| Pelco Low Vision Aid System       | Pelco Sales, Inc.   | N.A.              | 1,325        |
| Videovision T.V. Recording System | Videovision, Inc.   | N.A.              | 1,095        |

Electronic travel aids, on the other hand, because of their potential applicability and uniqueness, were funded through federal sources at various stages. Two notable examples are the Sonicguide and the Bionic Laser Cane. Both are commercially available in the \$2,000 range and require substantial training.

The Sonicguide, developed primarily in England and New Zealand with funding from these governments, is a complex device made up of ultrasonic sensors built into a spectacle frame. It provides information on the direction, distance and surface characteristics of an object within the immediate environment and travel path of a blind user.

The Bionic Laser Cane was developed in the U.S. by Bionic Instrument with the dollar support of the Veterans Administration. It emits pulses of infra-red light which are reflected by terrain surfaces, including drop-offs in the user's path. The reflections are then transmitted back to the user in the form of audio tones and a tactile buzzer. (See Exhibit X, below.)

Mobility Aids -  
by Type, Source, Sales and Price -  
January, 1976 - June, 1977

| <u>Type</u>       | <u>Source</u>       | <u>Units Sold</u> | <u>Price</u> |
|-------------------|---------------------|-------------------|--------------|
| Sonicguide        | Telesensory Systems | 163               | \$2,350.00   |
| Bionic Laser Cane | Bionic Instruments  | 150               | 1,950.00     |

Three examples of reading aids developed recently in the U.S. for blind persons are the Optacon, manufactured by Telesensory Systems, Inc., the Mauch Stereotoner, manufactured by Mauch Laboratories, and the Audio-Reading Machine, manufactured by the Kurzweil Computer Products, Corp. The Optacon has been widely distributed in the U.S. while the Stereotoner has had a very limited distribution so far.



Each of these has received massive federal support for development.  
(See Exhibit XI, below.)

Reading Machines -  
by Type, Source, Sales and Price -  
January, 1976 - June, 1977

| <u>Type</u>              | <u>Source</u>           | <u>Units Sold</u> | <u>Price</u> |
|--------------------------|-------------------------|-------------------|--------------|
| Optacon                  | Telesensory Systems     | 1,134             | \$2,395.00   |
| Stereotoner              | Mauch Laboratories      | 85 (since 1972)   | 1,250.00     |
| Kurzweil Reading Machine | Kurzweil Computer Corp. | 9                 | 50,000.00    |

The Optacon is a compact, portable electronic reading aid that converts the image of a printed letter into a vibrating tactile form that a blind person can feel with one finger. The user must be trained, of course, to recognize the various forms.

The Mauch Stereotoner is a portable, battery-powered device that translates printed letters and words into stereophonic tone patterns that the blind user learns to recognize as letters and symbols.

Recently, reading machines using a computer and a voice output have been developed. The first one on the market is the Kurzweil Reading Machine produced by Kurzweil Computer Corporation, which converts ordinary printed materials into normal full-word English speech. This machine is unique in that two of the organizations of blind persons in the U.S. have strongly endorsed and participated in its promotion. However, basic support has been provided through a joint grant from BEH, RSA and VA.

Efforts are also underway by Telesensory Systems, Inc. and Mauch Laboratories to equip their hand-held reading machines with a speech output.

Another sensory aid which has been developed primarily through the efforts of both RSA and private entrepreneurs is the computer braille terminal.

Both Triformation Systems, Inc. and the Massachusetts Institute of Technology offer high-speed braille printers that produce brailled print-outs from computers, magnetic cassettes and other sources of coded information. Some of the Triformation terminals have keyboards which allow for input to the computer as well.

In addition, American Systems, Inc. has perfected an audio-response system which delivers services over telephone lines to its users on a time-sharing basis. This system consists of a configuration of computer machines that includes the terminal, a keyboard that the user operates to address the system and a loudspeaker over which the user hears, in spoken English, the system's response. (See Exhibit XII, Page 15.)



Braille Computer Outputs and Terminals -  
by Type, Source, Sales and Price -  
January, 1976 - June, 1977

| <u>Type</u>                                      | <u>Source</u>                            | <u>Units Sold</u> | <u>Price</u> |
|--------------------------------------------------|------------------------------------------|-------------------|--------------|
| LED 120 Computer<br>Terminal Printer             | Triformation Systems                     | 110               | \$13,500.00  |
| Braillenboss                                     | Massachusetts Institute<br>of Technology | 6 (est)           | 6,500.00     |
| Audio-Response<br>Time-Sharing<br>Service Bureau | American Systems, Inc.                   | 3                 | 150,000.00   |

Another category of devices in the development stage which holds great promise for blind persons is glucose analyzers. Three firms, Triformations, Inc., Science for the Blind Products, and Georgia Institute of Technology, as well as the Hartford General Hospital, Hartford, Connecticut, are presently developing devices with which blind diabetics may be able to analyze the glucose content of their urine samples. These will assist them to adjust their activities, diet and medication.

From the models which I have presented in the preceding tables and charts, you can see that the way in which sensory aids are developed in the United States is extremely complex. Although there is no centralized control of funding, the major federal agencies maintain coordination to allow for the joint funding of some efforts and the reduction of duplication. School children, students in college or training programs or persons seeking employment receive a great deal more government support for sensory aids than do older persons who are blind or adults who are partially sighted.

Because the blindness market is a relatively small market within the American economy, manufacturers of sensory aids have increased start-up costs and/or risks. In addition, competition for the research dollar in sensory aids is fierce with the result that some worthwhile programs cannot be funded.

One essential element in the development of any sensory aid is a strong leader or leaders within the subject "system". It does not seem to matter, however, whether the leader is in the service community, is a private entrepreneur or a government official.

Comments: Suggestions for the Future

The greatest promise for the future seems to lie in the utilization of micro-processor and mini-computer technology for the development of sensory aids for blind persons. First, these processes allow a better, cheaper spoken output to be attached to most devices having a digital display available for the sighted. Second, micro-processors allow information to be partially "digested". This means that the



output of mobility devices which is information about the user's environment could be analyzed and transmitted to the blind user in a form which is more easily recognizable to him.

Pre-processing circuits within video low vision aids would help increase contrast and enhance the borders of images.

There are some devices coming out of Europe which make extremely effective use of micro-processor technology. These are the so-called "paperless" braille writers such as the braille cassette recorder now being manufactured by the Elinfa group in France. The AFB is currently assisting the developers with plans for demonstrating and distributing this device in the United States.

With the Elinfa recorder, a blind person can silently and quickly record braille directly onto ordinary tape cassettes by typing the braille on a keyboard made up of the six classic braille keys plus one key for spacing. Later, the braille can be played back on the recorder's built-in display at a speed determined by the reader. Playback units of this kind hold great promise for lowering the cost of braille books since approximately 400 pages of braille can be placed on one standard 90-minute cassette.

The future of the development of sensory aids for the blind and visually handicapped looks very positive. The participation of private entrepreneurs in the development, manufacturing and distribution of devices has been a very healthy stimulating factor in the United States, and we feel that the success to date will stimulate increased efforts in the future.



HV1701 Apple, Loyal E. c.2  
Ap52 THE DEVELOPMENT AND DELIV-  
ERY OF SENSORY AIDS IN THE  
UNITED STATES.

Date Due (1977)

|                    |  |  |  |
|--------------------|--|--|--|
| <del>10-2-77</del> |  |  |  |
| 10-2-77            |  |  |  |
|                    |  |  |  |
|                    |  |  |  |
|                    |  |  |  |
|                    |  |  |  |
|                    |  |  |  |
|                    |  |  |  |
|                    |  |  |  |
|                    |  |  |  |
|                    |  |  |  |

AMERICAN FOUNDATION FOR THE BLIND  
15 WEST 16th STREET  
NEW YORK, N. Y. 10011

